

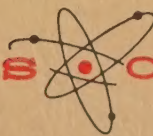
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***Vitro* ELECTRONICS**

A DIVISION OF VITRO CORPORATION OF AMERICA
919 JESUP-BLAIR DRIVE • SILVER SPRING, MARYLAND

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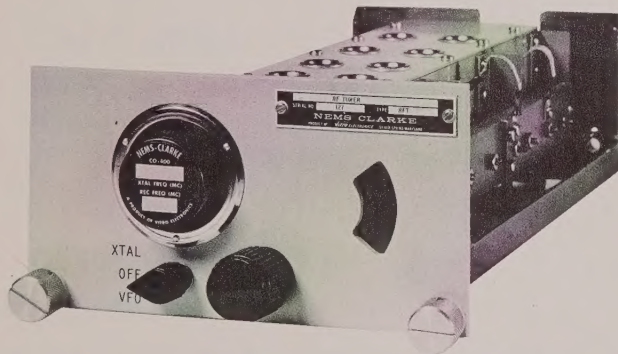


UNCLASSIFIED

JULY 1965



**RF TUNER
RFT-106A
(2200-2300 MC)**



• PRODUCED BY

***Vitro* ELECTRONICS**

A DIVISION OF VITRO CORPORATION OF AMERICA

919 JESSUP BLAIR DRIVE • SILVER SPRING, MARYLAND
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SECTION 1. GENERAL DESCRIPTION

1.1 Purpose of Equipment

The RFT-106A, RF Tuner, is designed to plug into and be an integral part of the Nems Clarke R-1037E, R-1074, and R-2074 Multi-Range Telemetry Receivers. The RF tuner selects antenna input signals in the 2200 and 2300 mc range and converts them to a 30 mc IF frequency for use in the incorporated receiver. Power to operate the tuner is supplied by the receiver.

1.2 Physical Description

Refer to Figure 1-1. RFT-106A, RF Tuner, Overall View.

The physical dimensions of the RFT-106A, RF Tuner, are as follows: 3-1/4 inches high, 6-5/6 inches wide, and 13-11/16 inches deep. The RF tuner is mounted on a chassis constructed of heavy gauge aluminum. Complete shielding is provided when the RF tuner is plugged into the receiver. All connections to the RF tuner, including the input power, are made through mating plugs in the receiver.

Table 1-1. Performance Specifications, RFT-106A

Tuning Range:	2200 to 2300 mc VFO and crystal modes. 2150 to 2350 mc crystal control (upon special request)
Noise Figure:	14 db maximum
Image Rejection:	60 db minimum
IF Rejection:	80 db minimum
First Local Oscillator:	VFO or crystal controlled
First Local Oscillator Stability:	Crystal mode: 0.002% with oven; 0.005% without oven. VFO mode: 0.002%/1°C
Dynamic Range:	100 mv
Output Frequency (IF):	30 mc
IF Amplifier Bandwidth :	4.5 mc $\pm$ 10%
Tuner Gain:	30 db $\pm$ 3 db

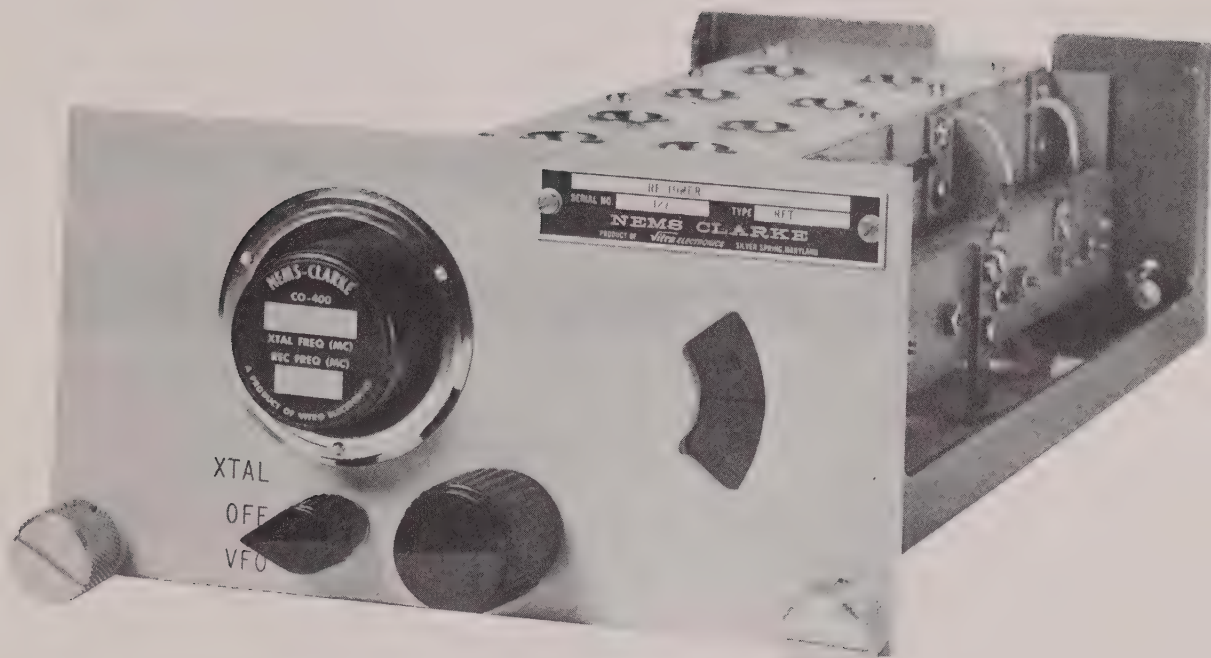


Figure 1-1. RF Tuner, Overall View

Table 1-2. List of Tubes and Semiconductors (RFT-106A)

30 MC IF PREAMPLIFIER, A1

<u>Reference Designation</u>	<u>Description</u>	<u>Function</u>	<u>Type</u>
CR1	Zener Diode	Delay Circuit	1N751A
CR2	Zener Diode	Voltage Constant	1N979B
V1	Tube	Cascode Amplifier	7586
V2	Tube	Cascode Amplifier	7587

BALANCED MIXER, A2

<u>Reference Designation</u>	<u>Description</u>	<u>Function</u>	<u>Type</u>
CR1, CR2	Diode	Rectifier	MA4351B (Matched pair)

CRYSTAL OSCILLATOR, AMPLIFIER, A3

<u>Reference Designation</u>	<u>Description</u>	<u>Function</u>	<u>Type</u>
V1	Tube	Crystal Oscillator-Tripler	7587
V2	Tube	VFO-Tripler	7587
V3	Tube	Tripler	7587
V4	Tube	Amplifier	7587

SOLID STATE X6 MULTIPLIER, A4

<u>Reference Designation</u>	<u>Description</u>	<u>Function</u>	<u>Type</u>
CR1	Varactor Diode	Harmonic Multiplier	N2101C

SECTION 2. INSTALLATION

2.1 General

The RFT-106A, RF Tuner, is designed to simply plug into the front panel of the Nems Clarke R-1037E, R-1074 and R-2074 Multi-Range Telemetry Receivers. After the two fastening screws on the front panel of the RF tuner are tightened down to the receiver, the installation is complete.

SECTION 3. OPERATION

3.1 General

Refer to Figure 1-1. RF Tuner, Overall View.

The RFT-106A, RF Tuner, contains two operating controls, both located on the front panel of the tuner. The selector switch determines the mode of operation for the local oscillator, either crystal or VFO. The tuning knob selects the frequency of the antenna input signal and adjusts the RF tuner for an optimum response at the selected frequency.

To operate the RF tuner in the VFO mode of the local oscillator, place the selector switch in the "VFO" position, and turn the tuning knob until the frequency dial reading corresponds to the desired received frequency, within the 2200 to 2300 mc range, of the antenna input signal.

To operate the RF tuner in the crystal mode of the local oscillator, place the selector switch in the "XTAL" position, and turn the tuning knob until the frequency dial reading corresponds to the antenna input frequency for which the installed crystal was selected.

The RFT-106A, RF Tuner was designed such that the crystal in the local oscillator can be easily replaced from the front panel, thus making it possible to readily utilize the full operating frequency range of the RF tuner (2200 to 2300 mc) in the crystal mode. To comply with the operating frequency range, only crystals with a fundamental frequency within the range of 40.373 mc to 44.074 mc can be used. Use the equation shown in part 4.1 of Section 4 to determine the fundamental frequency of a crystal needed in order to receive a desired antenna input frequency.

The crystal is located in the crystal oven which is plugged into the front panel of the RF tuner. In order to replace the crystal, proceed as follows:

1. Remove the crystal oven from the RF tuner by directly pulling it out of its socket.

2. Loosen the three screws on the crystal oven cover, and remove the cover.
3. Remove the retaining clamp which secures the crystal.
4. Replace the crystal, and reverse the above procedure.

SECTION 4. THEORY OF OPERATION

4.1 General

Refer to Figure 4-1. RFT-106A, RF Tuner, Functional Block Diagram.

The antenna RF input drives the four section Preselector Z1 which is manually tunable to any frequency within the 2200 to 2300 mc range and which produces a minimum 3 db bandwidth of 10 mc. The output of the Preselector Z1 feeds the hybrid ring Balanced Mixer A2 which is fabricated using strip line techniques. The balanced mixer also receives drive from the Local Oscillator, Amplifier A3 via the Solid State X6 Multiplier A4. The local oscillator, amplifier and the solid state X6 multiplier are tuned such that the output of the solid state Multiplier is 30 mc above the antenna RF signal frequency. The balanced mixer compares the antenna RF signal with the signal from the solid state multiplier and produces a 30 mc frequency difference. This 30 mc IF signal from the balanced mixer drives the low noise cascode 30 MC IF Preamplifier A1 which provides amplification to give the RFT-106A, RF Tuner, an overall gain of 30 db.

The Local Oscillator, Amplifier A3 can be operated in either crystal or VFO mode. The mode of operation is selected by the selector switch on the front panel of the RF Tuner. Both the crystal and VFO oscillators operate in a fundamental frequency range of 40.373 mc to 44.074 mc. The Local Oscillator, Amplifier A3 provides a nine times multiplication of the fundamental operating frequency of the oscillators, and the Solid State X6 multiplier A4 provides an additional multiplication of six times.

Since the total multiplication of the fundamental frequency is fifty-four (54) times at the output of the solid state multiplier and since the frequency mixed with the antenna RF input is 30 mc above the antenna RF input, the following formula is used when operating in the crystal mode to determine the fundamental crystal frequency required to operate the RFT-106A at the desired antenna RF input frequency:

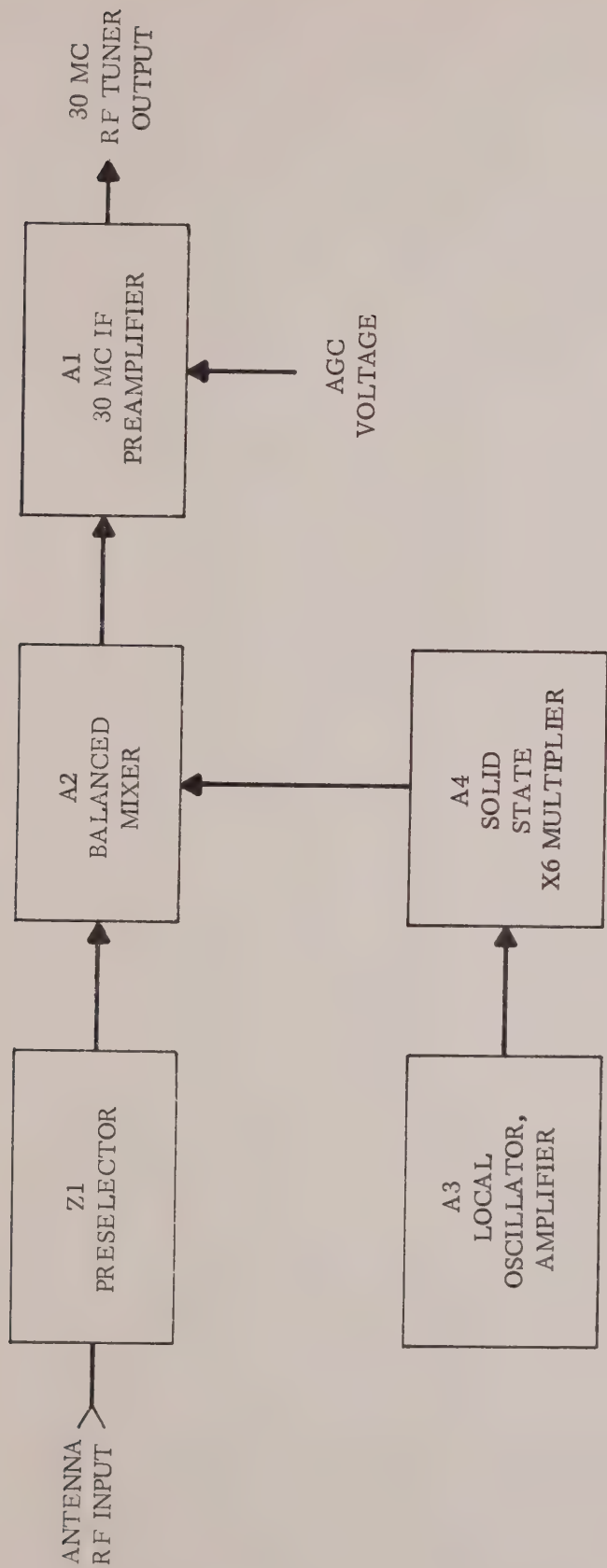


Figure 4-1. RF Tuner, Functional Block Diagram

$$\text{Crystal Frequency (in mc)} = \frac{F_o + 30}{54}$$

F_o = the frequency of the antenna RF input in mc.

An AGC voltage from the incorporated receiver is fed back to the RFT-106A and is applied to the 30 MC IF Preamplifier A1 to control the gain of the RFT-106A, RF Tuner.

4.2 Detailed Circuit Description

4.2.1 Preselector Z1

The Preselector Z1, is a passive network with high selectivity for the antenna RF input signals to the RFT-106A, RF Tuner. The preselector consists of a four section cavity resonator manually tunable to any frequency within the 2200 to 2300 mc range. The output of the preselector has a minimum 3 db bandwidth of 10 mc, a maximum 30 db bandwidth of 60 mc, and a maximum insertion loss of 1.5 db and a maximum VSWR of 1.5:1 is characteristic of the preselector.

A gear reduction train provides tracking between Preselector Z1 and Local Oscillator, Amplifier A3.

The Preselector Z1 is a replaceable part and is not repairable in the field. It is designed for a long life of trouble-free performance and should not generally have to be replaced.

4.2.2 30 MC IF Preamplifier A1

Refer to Figure 7-1, 30 MC IF Preamplifier, Schematic Diagram

The 30 mc IF input at jack J1 is applied to the pi network composed of coil L1 and capacitors C1 and C4 which provides impedance and noise matching between the 30 mc IF input and input to tube V1. The neutralizing coil L3, in conjunction with capacitor C4, minimizes the noise figure.

Tubes V1 and V2 comprise a cascode input stage which provides low noise, high gain amplification. Coil L2 is a dc ground return and a RF signal to ground isolator for the

cathode circuit of tube V2.

Double tuning of the output of cascode stage V1 and V2 is performed by coils L4 and L6. Coil L5 provides inductive mutual coupling, determining the amount of coupling between coils L4 and L6. A bandwidth reduction is performed on the 30 mc RF signal by this double tuned circuit.

The ac coupling capacitor C11 feeds the grid input of the output amplifier formed by tube V3. Zener diode CR2 establishes a constant screen grid voltage of about ± 57 vdc.

The 30 mc RF signal at the plate output of amplifier V3 is again double tuned by coils L7 and L9. The circuit formed basically by coils L7, L8 and L9 operates in an identical manner to the network formed by coils L4, L5 and L6. A further bandwidth reduction is performed on the 30 mc IF Preamplifier.

A negative AGC voltage is fed externally to feedthru capacitor C14. Zener diode CR1 breaks down when an AGC voltage more negative than about -4 vdc is applied to its anode. A negative feedback voltage (about 4 vdc less negative than the AGC voltage at the anode of zener diode CR1) is then coupled to the grids of tubes V1 and V3, reducing the gain of these tubes and preventing overloading. If the AGC voltage is less negative than about -4 vdc, zener diode CR1 appears as an open circuit, and the AGC voltage has no effect on tubes V1 and V3.

4.2.3 Balanced Mixer A2

The balanced mixer is fabricated from copper clad, glass filled Teflon board. Strip line techniques are incorporated to perform the desired mixing operation.

Refer to Figure 7-3, Balanced Mixer, Equivalent Schematic Analogy.

Two RF inputs are fed into the strip line hybrid ring: one from the Preselector Z1 and one from the Local Oscillator, Amplifier A3 via the Solid State X6 Multiplier A4. The input from the solid state multiplier is tuned 30 mc above the input frequency from the preselector. The hybrid ring configuration provides high isolation between the two inputs, preventing antenna and oscillator signal leakage. The matched pair of point contact diodes

CR1 and CR2 conduct the input signals to the center of the hybrid ring: one diode conducting the upper half of the input signals, the other diode conducting the low half of the input signals. An IF signal of 30 mc, a frequency equal to the difference between the two input frequencies, is thus established at the output of the Balanced Mixer located on the center of the hybrid ring.

Capacitor C1 is an output bypass capacitor, fabricated using strip line techniques.

4.2.4 Local Oscillator, Amplifier A3

Refer to Figure 7-4. RFT-106A, RF Tuner, Schematic Diagram.

Local Oscillator, Amplifier A3 is a selectable fixed or variable frequency oscillator which successively triples and amplifies fundamental frequencies in the range of 40.373 mc to 44.074 mc. The mode of operation for this all-nuvistor module is selected by front panel switch S1. In the XTAL position, S1 activates crystal oscillator V1 by connecting ± 150 vdc to the screen grid. Similarly, in the VFO position, S1 activates variable frequency oscillator V2 by connecting ± 150 vdc to its screen grid. In either case, the fundamental frequency of the selected oscillator is set in the oscillator plate circuit, and the resultant signal is coupled through C21 to the grid of V3.

In the network of crystal oscillator-trippler V1, to the grid to cathode feedback capacitor C8 is an integral part of the capacitive divider composed of capacitors C2, C8 and C9. Screen bypass capacitor C1 prevents overheating of V1. Inductors L2 and L3 provide RF signal isolation from ground.

In the network of VFO-trippler V2, capacitors C12 through C19 and inductor L4 form a tuned tank circuit which controls the cathode to grid reactance of V2. Capacitors C12, C14 and C15 are adjusted to produce for VFO-trippler V2 a fundamental oscillating frequency within the range of 40.373 mc to 44.074 mc. Inductor L5 provides RF signal isolation of the cathode of V2 to ground. Screen bypass capacitor C20 prevents overheating of V2.

In the common plate circuit of V1 and V2, RF signal isolation to the ± 150 vdc bias supply is provided by isolation coil L1 and bypass capacitor C4. Capacitors C6 and C7,

in conjunction with capacitor C5, tune the plate circuit to the third harmonic of the fundamental oscillating frequency of V1 or V2.

Amplifier stage V3 functions as a frequency tripler for the oscillator output signal. The frequency at the plate output of V3 is three times the frequency fed into the grid, as provided by tuning capacitors C25 and C26 to the third harmonic of the signal frequency at the grid. Resistors R6 and R7 form a voltage divider which provides a 50 ohm impedance for the oscillator output at jack J1. Inductors L6 and L7 and capacitor C30 isolate the RF output signal of V3 from the plate bias supply.

The plate output of tripler V3 is ac coupled by capacitor C31 to the grid of muvistor tube amplifier V4. The plate output of amplifier V4 is tuned by capacitors C35, C36 and C40 to the same frequency that is applied to the grid. The RF output signal of amplifier V4 is inductively coupled by coils L8 and L9 to the output of the Local Oscillator, Amplifier at jack J2. Inductors L8 and L13 and capacitor C38 isolate the RF output signal of amplifier V4 from the plate bias supply.

The manual frequency tuning control on the front panel of the RFT-106A is mechanically coupled to the tuning adjustments of capacitors C6, C15, C25 and C36 via the RFT gear box assembly and the tuning bar.

When operating in the VFO mode, stages V2 and V3 and V4 of the local oscillator, amplifier are thus adjusted by capacitors C6, C15, C25 and C36 to operate at the proper frequencies necessary to correspond to the selected input frequency on the tuning dial. When operating in the crystal oscillator mode, stages V1, V3 and V4 are adjusted to operate at the frequencies necessary to correspond to the fundamental frequency of the crystal used. The crystal frequency is proportional to the frequency of the selected input signal to the RFT-106A, and correspondingly determines the setting on the tuning dial.

4.2.5 Multiplier.

This multiplier is fabricated from copper clad, glass filled Teflon-board. Incorporating strip line techniques, a frequency multiplication of six times is produced.

Refer to Figure 7-2, Multiplier Equivalent Schematic Analogy.

An equivalent electrical circuit to the strip line technique utilized is discussed in the following paragraph. Varactor CR1 and resistor R1 are the only physical components that are in this multiplier, while all the capacitors and inductors are analogies of the strip lines.

The RF input from the Crystal Oscillator, Amplifier is applied to the low pass filter composed of inductors L1 and L2 and capacitors C1 and C2 via the load matching resistor R1. This low pass filter drives varactor diode CR1 which produces many harmonics of the applied frequency. The bandpass filter composed of inductors L3 through L6 and capacitors C3 and C4 eliminate all but the sixth harmonic from the output. Thus, an effective multiplication of six times is performed on the input signal frequency.

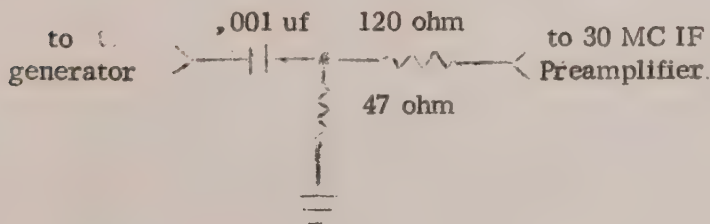
SECTION 5. ALIGNMENT AND ADJUSTMENT PROCEDURES

5.1 General

This section contains alignment and adjustment procedures for the RFT-106A, and a list of required test equipment. When aligning the tuner, refer to the schematic diagrams in Figures 7-1, 7-3 and 7-4. Also refer to Figures 6-1 through 6-6 for the location of components in the RFT-106A.

5.2 Required Test Equipment

1. Oscilloscope, Tektronix Model 503
2. Noise Figure Meter, Hewlett-Packard Model 340B
3. UHF Noise Source, Hewlett-Packard Model 349A
4. Frequency Counter, Hewlett-Packard Model 524B
5. Sweep Generator, Hewlett-Packard 692B
6. Power Meter, Hewlett-Packard Model 431B
7. VTVM, RCA WV-98C
8. Power Supply, ± 12.6 vdc, ± 150 vdc, 6.3 vac
9. Test Crystals, 40.373 mc, 42.037 mc, 44.074 mc
10. Attenuator Pads (2); 50 ohm, 10 db; Applied Research HFA.
11. 50 ohm detector
12. 30 mc Post Amplifier
13. Capacitor, 0.001 microfarad paper
14. Mixer simulator;



5.3 Initial Setup

1. Remove RFT-106A tuner module from receiver
2. Connect tuner to an external power supply capable of supplying ± 12.6 vdc, -12.6 vdc, ± 150 vdc, and 6.3 vac.

5.4 Local Oscillator, Amplifier Alignment (A3).

1. Remove top cover from the Local Oscillator, Amplifier.
2. Rotate front panel tuning knob maximum counterclockwise (low end of tuning range). The tuning bar which mechanically ties together C6, C15, C25, and C36 should be 9/16-inch away from the chassis.
3. Rotate C15 until its piston protrudes approximately 1/16-inch from the top of the capacitor. Lock the dial stop at this point.
4. Plug a 40.373 mc test crystal into the oven. Plug crystal assembly into the octal socket on the front panel. Place S1 in the crystal position. Apply voltage to the unit.
5. Rotate front panel tuning knob approximately 1-1/2 turns clockwise
6. Connect a VTVM at TP1 and adjust C7 until a reading of approximately -12 vdc is obtained
7. Connect a frequency counter at P2-A1. The frequency should be 121.119 mc (three times the crystal frequency). Remove 40.373 mc crystal.
8. Plug a 44.074 mc test crystal into the oven. Plug crystal assembly into the octal socket on the front panel.
9. Rotate front panel tuning knob clockwise until tuning bar is approximately 1-3/16 inches from chassis. At this point ($\pm 1/16$ inch) the tuning mechanism should be against the mechanical stop. If not, adjust stop as required.

10. Rotate front panel tuning knob one turn counterclockwise from stop (see step 9 above) and observe VTVM reading at TP1. This reading should be -4.2 vdc. Adjust C6 and C7 to meet this condition.
11. Observe frequency reading of counter connected at P2-A1. The frequency should be 362.222 mc (three times the crystal frequency).
12. Place S1 in VFO position. Rotate front panel tuning knob maximum counterclockwise (to low frequency range) until tuning mechanism is against mechanical stop.
13. Observe frequency reading on counter. The frequency should be approximately 121.1 mc. Adjust C14 to meet this condition.
14. Rotate front panel tuning knob throughout its range and observe VTVM reading at TP1. This reading should never be less negative than -4 vdc. Adjust C6 and C7 to meet this condition.
15. Rotate front panel tuning knob maximum clockwise (to high frequency range) until tuning mechanism is against mechanical stop.
16. Observe frequency reading on counter. The frequency should be approximately 132.2 mc. Adjust C47 to meet this condition.
17. Rotate front panel tuning knob maximum counterclockwise (to low frequency range) until tuning mechanism is against mechanical stop. The frequency reading on the counter should still be approximately 121.1 mc. (It may be necessary to touch-up C14 to meet this condition.) If difficulty is encountered in adjusting the end points of the tuning range, adjust C12 slightly to obtain the desired end frequency.
18. Replace top cover of Local Oscillator, Amplifier. Secure cover tightly with screws. Repeat steps 13 through 18.
19. Disconnect VTVM from TP1 and connect it to TP2.
20. Rotate front panel tuning knob throughout its range and observe VTVM reading at TP2. This reading should never be less negative than -3 vdc. Appropriate adjustment of C26, and C25 will meet these conditions.

NOTE

C26 controls tracking of the tripler stage V3 at the low end of the band. C25 controls tracking of V3 at the high end of the band. L6 controls tracking at mid-band. Normally, it is not necessary to adjust L6.

21. Disconnect Solid-State X6 Multiplier A4 from J2 of A3. Connect a power meter through a 50 ohm 20 db pad to J2 of A3.
22. Rotate front panel tuning knob throughout its range and observe power meter reading. This reading should not be less than 220 milliwatts over the operating range. If this power reading cannot be maintained, adjust C35 (low end tracking), C36 (high end tracking) and adjust the coupling of L9.
23. Disconnect power meter from J2-A3. Connect Solid-State X6 Multiplier A4 to J2 -A3.

5.5

Solid -State X6 Multiplier Alignment (A4)

1. Disconnect P2 of balanced mixer A2 from J1-A4. Connect power meter through a 50 ohm 10 db pad to J1 -A4.

NOTE

Solid-State X6 Multiplier A4 is factory adjusted to give a power output of .5 to 2 milliwatts throughout its tuning range for input drives between 220 and 300 milliwatts. If the output drops below .5 milliwatt, check the drive power from A3.

5.6

Oscillator-Preselector Tracking and Noise Figure Adjustment

1. When the proper power level is obtained from A4, connect J1-A4 to J1 of balanced mixer A2.
2. Connect J2-A2 to J1 of Preamplifier A1.
3. Connect J2-A1 through a post amplifier to the input of a noise meter.
4. Connect noise meter output to antenna input W4-P1.

5. Place S1 in the CRYSTAL position. Plug a 44.074 mc test crystal into the oven. Plug crystal assembly into the octal socket on the front panel.
6. Rotate front panel tuning knob maximum clockwise (to high frequency range) until tuning mechanism is against mechanical stop. Rotate tuning knob counterclockwise approximately one turn.
7. Loosen mechanical coupling between oscillator and preselector. Tune preselector until noise figure is less than 11 db.
8. Tighten mechanical coupling between oscillator and preselector.
9. Plug a 40.373 mc test crystal into the crystal socket.
10. Rotate front panel tuning knob maximum counterclockwise (to low frequency range) until tuning mechanism is against mechanical stop. The proper noise figure (less than 11 db) will be obtained about 1-1/2 turns clockwise from the stop.
11. Place S1 in the VFO position. Adjust C14, C12, and C15 until the proper noise figures are obtained over the 2200 to 2300 mc range.

5.7

30 mc IF Alignment Procedure

1. Connect the sweep generator to the grid of V3 through a 0.001 mfd blocking capacitor.
2. Connect the 50 ohm detector to A1-J2 and connect the oscilloscope to the output of the detector.
3. Rotate R9 to maximum resistance position.
4. Adjust L7 and L9 for an over coupled response centered at 30 mc.

NOTE

the response shown here has characteristics of a peak to valley dip of approximately 2-db maximum and a peak to peak separation of approximately 9 mc. (Refer to Figure 5-1)

5. Should any difficulty be encountered in obtaining the desired

response, a slight adjustment to L8 spreading turns or positioning the coil with respect to the chassis wall may be required.

6. Connect the sweep generator through a 0.001 mfd blocking capacitor to pin 8 of V2.
7. Tune L4 and L6 to obtain a peak to valley dip of 2 db maximum and a peak to peak separation of 6 mc.
8. The overall gain should be $16 \text{ db} \pm 1 \text{ db}$.
9. Should any tilt be encountered which cannot be eliminated by adjusting L4 or L6, touch up L7 or L9.
10. Connect the sweep generator to J1 through a mixer simulator.
11. Adjust L3 and C4 to give the following response:
A 3 db bandwidth is equal to 5 mc. With a peak to peak separation of $4 \text{ mc} \pm 10\%$, the overall gain should be $30 \text{ db} \pm 3 \text{ db}$.
Should any tilt be encountered, touch up the tuning of L4, L6 L7 or L9.
12. Adjust C4 for minimum noise (2.5 db maximum).
13. Recheck overall response and reset L3 if necessary to center 30 mc.

5.8 AGC Characteristics Alignment

The RFT-106A is to be set for a gain of 30 db at 0 volt AGC and zero db at -8 volts AGC.

1. Connect the signal generator to the 30 mc post amplifier input.
2. Turn the signal generator to 30 mc and adjust the output to give a convenient indication on the 30 mc post amplifier output meter. Note the signal generator attenuator reading.
3. Connect the signal generator to the IF preamplifier input and the 30 mc post amplifier to the IF preamplifier output A2 of P2.
4. Decrease the signal generator output 30 db from the attenuator setting in step 2.
5. Adjust gain control R9 on the IF preamplifier chassis until the post amplifier meter indication is the same as in step 2.
6. For 0 db gain at -8 vdc AGC, connect -8 vdc from a negative voltage source to C14.

7. Return the signal generator attenuator reading to the setting as in step 2.
8. Adjust AGC slope control R17 (located on the wraparound) until the post amplifier meter reading is the same as in step 2.
9. Adjustment of gain control potentiometer R9 may detune slightly the 30 mc IF response. This condition can be corrected by readjustment of L7 and L9 on the IF preamplifier.

5.9 Typical Voltage Readings.

Refer to figure 7-1, 30 MC IF Preamplifier Schematic Diagram and figure 7-4, RFT-106A, RF Tuner Overall Schematic Diagram. All voltage readings are taken with -8 vdc applied to plug P2, pin 14 on the back panel of the tuner and with potentiometer R17 on the RF Tuner main chassis adjusted such that -4.6 vdc appears at feedthru capacitor C14 on the 30 MC IF Preamplifier.

Table 5-1. Voltage Measurements

30 MC IF PREAMPLIFIER

<u>Tube</u>	<u>Plate</u>	<u>Cathode</u>	<u>Grid (pin 2)</u>	<u>Grid (pin 4)</u>
V1	+ 90 vdc	+ 0.86 vdc		- 0.98 vdc
V2	+103 vdc	+0.52 vdc		
V3	+144 vdc	+0.70 vdc	+57 vdc	+ 1.0 vdc

Local Oscillator and Amplifier

V1	+123 vdc	0 vdc	+69 vdc	-6vdc
V2	+123 vdc	0 vdc	+69 vdc	-6 vdc
V3	+148 vdc	+1.0 vdc	+62 vdc	-13 vdc
V4	+148 vdc	+0.8 vdc	+83 vdc	-6 vdc

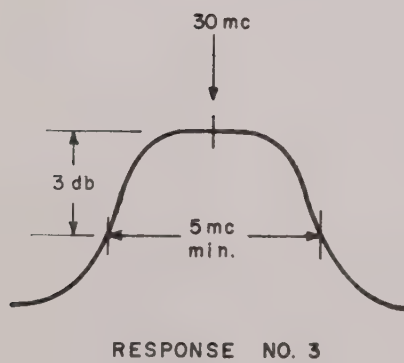
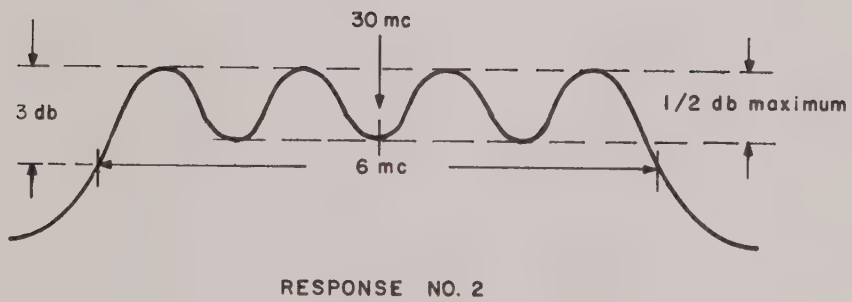
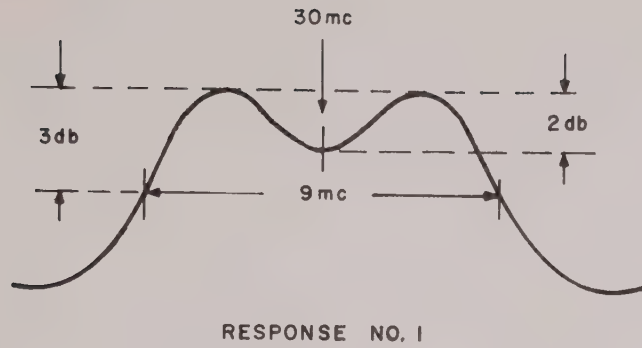


Figure 5-1. 30 MC IF Preamplifier Alignment Waveforms

SECTION 6. REPLACEABLE PARTS

6.1 General

This section contains a list of replaceable parts in the RFT-106A RF Tuner. Refer to Tables 6-1 through 6-5.

When ordering replacement parts, give the equipment name and model number, reference designation number, and description of each item ordered.

Also included in this section are component location diagrams for the following:

- a) 30 MC IF Preamplifier
- b) Crystal Oscillator, Amplifier
- c) Multiplier

Refer to Figures 6-1 through 6-6 respectively.

6.2 Multiplier, Component Replacement Instructions.

Replacement of Varactor Diode CR1

Refer to Figure 6-2 Multiplier, Location of Components.

1. Remove the varactor diode access plate and the teflon slug in the circuit board.
2. Pry the varactor diode loose from its cavity, and scrape excess epoxy from copper on the circuit board, leaving a slightly rough surface on the copper strips.
3. Place a small amount of conductive epoxy (specified in the list of replaceable parts) on the ends of the copper strips on the circuit board.
Lay the replacement varactor diode into the cavity, making sure that the metal ends lay in the conductive epoxy. EPOXY MUST NOT TOUCH CERAMIC PART OF THE VARACTOR DIODE.
4. After epoxy has hardened, replace teflon slug in the circuit board, and screw varactor diode access plate in place.

6.2.2 Replacement of Resistor R1

Refer to Figure 6-2 Multiplier, Location of Components.

1. Remove the resistor access plate and the teflon slug in the circuit board.
2. Unsolder the resistor loose from the ends of the copper strips.
3. Trim leads of replacement resistor to $.06 \pm .01$ inches.
4. Lay replacement resistor in cavity and solder metal leads carefully to the copper strips, using a minimum amount of solder. Smooth solder to minimize buildup.
5. Replace teflon slug in the circuit board, and screw resistor access plate in place.

6.3 Balanced Mixer, Component Replacement Instructions

Replacement of the diodes in the Balanced Mixer is accomplished as follows:

1. Remove all screws holding the two circuit boards together.
2. With the circuit board (containing jacks J1, J2 and J3) facing downward, lift the other circuit board off.
3. Lift the insulator off from the center of the circuit board, and lift the diodes out of their cavities, recording the polarity orientations of the diodes.
4. Trim the leads of the replacement diodes to $.09 \pm .02$ inches. Flatten the metal leads parallel to each other, and keep matched pair of diode paired.

NOTE: Since the two diodes in the Balance Mixer are a matched pair, a single diode should not be replaced. Always replace both diodes, using another matched pair.

5. Lay diodes in the cavities, insuring that their polarity orientations are correct. Flat surface of leads should be parallel with the copper strips on which they rest.
6. Carefully position the insulator over the diode leads at the center of the circuit board, and carefully replace the other circuit board on top.
7. Replace all screws holding the two circuit boards together.

Table 6-1. RFT-106A, Main Chassis Components

<u>Reference Designation</u>	<u>Name and Description</u>	<u>Part Number</u>	
		<u>Vitro</u>	<u>Vendor</u>
A1	30 MC IF PREAMPLIFIER	200893-91	
A2	BALANCED MIXER	300750-90	
A3	LOCAL OSCILLATOR, AMPLIFIER	300662-90	
A4	SOLID STATE X6 MULTIPLIER	300754-90	
P2	CONNECTOR PLUG	91370536	Cannon DCMF-25W3P
S1	SWITCH, Modified	101940-01	
Z1	PRESELECTOR	200929-01	Microwave 910-4

Table 6-2. Replaceable Parts, 30 MC IF Preamplifier

Reference Designation	Name and Description	Part Number	
		<u>Vitro</u>	<u>Vendor</u>
C1	CAPACITOR: 15 pf, $\pm 5\%$, 500 v	90900795	Erie NPO-301
C2, C3	CAPACITOR: 470 pf, 10%, 500 v	90901470	Erie GP2-331
C4	CAPACITOR, Variable: 1.0 - 10.0 pf, 500 v	90950091	Roanwell SG11054
C5	CAPACITOR, Standoff: 001 uf, GMV, 500 v	90901547	Allen Bradley 5S5A
C6	CAPACITOR, Feed-Thru: .001 uf, GMV, 500 v	90901544	Allen Bradley FASC
C7	CAPACITOR: 4.7 pf, ± 0.25 pf, 500 v	90900390	Erie NPO-301
C8	CAPACITOR: .001 uf, $\pm 20\%$, 500 v	90901641	R2CC60Z5U102M EIA Spec. RS-198
C9	Same as C6		
C10	CAPACITOR: 2.4 pf, ± 0.1 pf, 500 v	90900210	Erie NPO-301
C11	CAPACITOR: 8.2 pf, ± 0.25 pf, 500 v	90900610	Erie NPO-301
C12, C14, C15	Same as C6		
C16, C17	Same as C5		
C18	Same as C6		
C19	CAPACITOR: 5.6 pf, ± 0.25 pf	90900450	Erie NPO-301
C20	CAPACITOR:	90900361	CC22CH040C MIL-C-20/3A
C21	CAPACITOR: 2.0 pf, ± 0.1 pf, 500 v	90900170	Erie NPO-301
C22	Same as C6		
C23	Same as C8		
CR1	DIODE	91600216	1N751A
CR2	DIODE	91600224	1N979B

Table 6-2. Replaceable Patts, 30 MC IF Preamplifier, (Cont'd)

Reference Designation	Name and Description	Part Number	
		Vitro	Vendor
J1, J2	CONNECTOR, Recpl.	91371830	Microdot 31-50
L1	COIL, RF: 2.2 uh	91150010	Wilco 209-11
L2	CHOKE, RF: 11 uh	90150043	Wilco 218-11
L3	COIL, Variable	102518-90	Vitro Electronics
L4	COIL, Variable	102518-91	Vitro Electronics
L5	COIL (See NOTE)	102517-90	Vitro Electronics
L6	COIL, Variable	102518-92	Vitro Electronics
L7	COIL, Variable	102518-93	Vitro Electronics
L8	Same as L5 (See NOTE)		
L9	COIL, Variable	102518-94	Vitro Electronics
R1	RESISTOR, Fixed Composition: 47 ohm, 5%, 1/2 w	93550160	Allen Bradley EB4705
R2	RESISTOR, Fixed Composition: 100 ohm, 5%, 1/2 w	93550290	Allen Bradley EB1015
R3	RESISTOR, Fixed Composition: 6.2 K, 5%, 1 w	93560350	Allen Bradley GB6225
R4, R5	RESISTOR, Fixed Composition: 2.7 K, 5%, 1/2 w (See NOTE)	93550780	Allen Bradley EB2725
R6	RESISTOR, Fixed Composition: 3.9 K, 5%, 1 w	93560275	Allen Bradley GB3925
R7	RESISTOR, Fixed Composition: 10 K, 5%, 1/2 w	93551020	RC20GF103J MIL-R-11
R8	RESISTOR, Fixed Composition: 510 ohm, 5%, 1/2 w	93550530	Allen Bradley EB5115
R9	RESISTOR, Variable Composition: 1 k, $\pm 10\%$, 1/2 w	93140018	Allen Bradley GA2N032S102UA
R10	Same as R4		
R11	RESISTOR, Fixed Composition: 100 K, 5%, 1/2 w	93551430	Allen Bradley EB1045

Table 6-2. Replaceable Parts, 30 MC IF Preamplifier, (Cont'd)

<u>Reference Designation</u>	<u>Name and Description</u>	<u>Vitro</u>	<u>Vendor</u>
R12	RESISTOR, Fixed Composition: 68 ohm, 5%, 1/2 w	93550220	Allen Bradley EB6805
R13	RESISTOR, Fixed Composition: 82 K, 5%, 1/2 w	93551400	Allen Bradley EB8235
R14	RESISTOR, Fixed Composition: 30 K, 5%, 1/2 w	93551200	Allen Bradley EB3035
R15, R16	Same as R4 (See NOTE)		
R17	Same as R11		
V1	TUBE	95400674	RCA 7586
V2	TUBE	95400678	RCA 8058
V3	TUBE	95400673	RCA 7587
XV1, XV2, XV3	SOCKET, TUBE	94450181	133-65-10-001

NOTE

L5 is wound around R5

L8 is wound around R16

Table 6-3. RFT-106A, Replaceable Parts, Balanced Mixer

<u>Reference Designation</u>	<u>Name and Description</u>	<u>Part Number</u>	
		<u>Vitro</u>	<u>Vendor</u>
J1, J2, J3	COLLAR & CONNECTOR ASSEMBLY	102683-91	
CR1, CR2	DIODE, Matched pair	91600343	Hewlett-Packard HPA2105
	WIRE, Buss: #20 tinned copper	95710050	New England

Table 6-3. RFT-106A, Replaceable Patts, Local Oscillator, Amplifier

Reference Designation	Name and Description	Part Number	
		Vitro	Vendor
C1	CAPACITOR: .001 uf, 20%, 500 v	90901641	R2CC60Z5U102M EIA-Spec, RS-198
C2	CAPACITOR: 51 pf 5%, 500 v	90901312	R1CC27COG510J EIA-RS-198
C3	CAPACITOR: 470 pf, 10%, 500 v	90901470	Erie GP2-331
C4	CAPACITOR, Standoff: 1000 pf, 500 v	90901547	Allen Bradley SS5A
C5	CAPACITOR: 10 pf, ± 0.1 pf, 500 v	90900640	Erie NPO-301
C6	CAPACITOR, Variable: 0.8-30 pf	90950061	Roanwell MGT-11047
C7	CAPACITOR, Variable: 0.5-8.5 pf, 1000 v	90950038	Roanwell MG 1309N
C8	CAPACITOR: 30 pf, 5%, 500 v	90901040	Erie NPO-308
C9	CAPACITOR: 20 pf, 5%, 500 v	90900880	Erie NPO-301
C10, 11	CAPACITOR, Feedthru; 1000 pf, 500 v	90901544	Allen Bradley FA5C
C12	CAPACITOR, Variable: 0.8-8.5 pf, 750 v	90950055	JFD VC20G
C13	Same as C2		
C14	CAPACITOR, Variable: 1.0-28 pf, 1000 v	90950094	JFD MC-603FL
C15	Same as C6		
C16	CAPACITOR: 56 pf, 5%, 500 v	90901324	R1CC27COG560J EIA-Spec RS-198
C17	CAPACITOR: 10 pf, 2%, 500 v	90900830	Erie NPO-301

Table 6-3. RFT-106A, Replaceable Parts, Local Oscillator, Amplifier (Cont'd)

<u>Reference Designation</u>	<u>Name and Description</u>	<u>Part Number</u>	
		<u>Vitro</u>	<u>Vendor</u>
C18	CAPACITOR: 5.1 pf, $\pm .25$ pf, 500 v	90900429	Erie NPO-301
C19	CAPACITOR 47 pf, 5%, 500 v	90901240	Erie NPO-308
C20	Same as C1		
C21	Same as C5		
C22, 23, 24	Same as C10		
C25	Same as C6		
C26	Same as C7		
C27	Same as C10		
C28, 29	Same as C1		
C30	Same as C4		
C31	CAPACITOR 3.9 pf, $\pm .25$ uuf, 500 v	90900350	Erie NPO-301
C32	Same as C10		
C33, 34	Same as C1		
C35	Same as C7		
C36	Same as C6		
C37	Same as C10		
C38	Same as C4		
C40	CAPACITOR, Variable: .5-8.5 pf, 1000 v	90950041	Roanwell MG-1309
J1, J2	CONNECTOR	91371830	Micro Dot 31-50
L1	COIL	102495-97	Vitro Elec.
L2	COIL .24 uh	91150001	Wilco 200-11

Table 6-3. RFT-106A, Replaceable Parts, Local Oscillator, Amplifier, (Cont'd)

Reference Designation	Name and Description	Part Number	
		Vitro	Vendor
L3	COIL: 1.2 uh, 10%	91150006	Wilco 206-11
L4	COIL	102405-91	Vitro Elec.
L5	COIL: 10 uh	91150042	Wilco W-100
L6	COIL	103397-01	Vitro Elec.
L7	COIL, RF: .68 uh	91149901	Wilco 203-11
L8	COIL	103398-01	Vitro Elec.
L9	COIL	103399-01	Vitro Elec.
L13	Same as L7		
R1	RESISTOR, Fixed Comp: 39 K, 5%, 1/2W	93551250	RC20GF393J MIL-R-11
R2	RESISTOR, Fixed Comp: 47 K, 5%, 1/2 W	93551290	RC20GF473J MIL-R-11
R3	RESISTOR, Fixed Comp: 3 K, 5%, 1/2W	93550800	RC20GF302J MIL-R-11
R4	RESISTOR, Fixed Comp: 36 K, 5%, 1/2W	93551240	RC20GF363J MIL-R-11
R5	Same as R1		
R6	RESISTOR, Fixed Comp: 100 K, 5%, 1/2 W	93551430	RC20GF104J MIL-R-11
R7	RESISTOR, Fixed Comp: 51 ohm, 5%, 1/2W	93550190	RC20GF510J MIL-R-11
R8	RESISTOR, Fixed Comp: 1 meg, 5%, 1/2 W	93551780	RC20GF105J MIL-R-11
R9	RESISTOR, Fixed Comp: 68 ohm, 5%, 1/2 W	93550220	RC20GF680J MIL-R-11

Table 6-3. RFT-106A, Replaceable Parts, Local Oscillator, Amplifier (Cont'd)

Reference Designation	Name and Description	Part Number	
		<u>Vitro</u>	<u>Vendor</u>
R10	Same as R1		
R11	RESISTOR, Fixed Comp: 10 K, 5%, 1/2 W	93551020	RC20GF103J MIL-R-11
R12	RESISTOR, Fixed Comp: 27 K, 5%, 1/2W	93551180	RC20GF273J MIL-R-11
R13	Same as R9		
R14	Same as R12		
R17	RESISTOR, Variable: 50 K, 20 %, 1/4 W	93140004	Bourns 2155-1-503
V1 thru V4	TUBE	95400673	RCA-7587

Table 6-4. RFT-106A, Replaceable Parts, Multiplier (X6)

Reference Designation	Name and Description	Part Number	
		Vitro	Vendor
CR1	VARACTOR DIODE	201316-01	N2101C
J1, J2	COLLAR AND CONNECTOR ASSEMBLY	102683-90	
R1	RESISTOR, Fixed Comp: 20 ohm, 5% , 1/2 W	93550055	RC20GF200J MIL-R-11

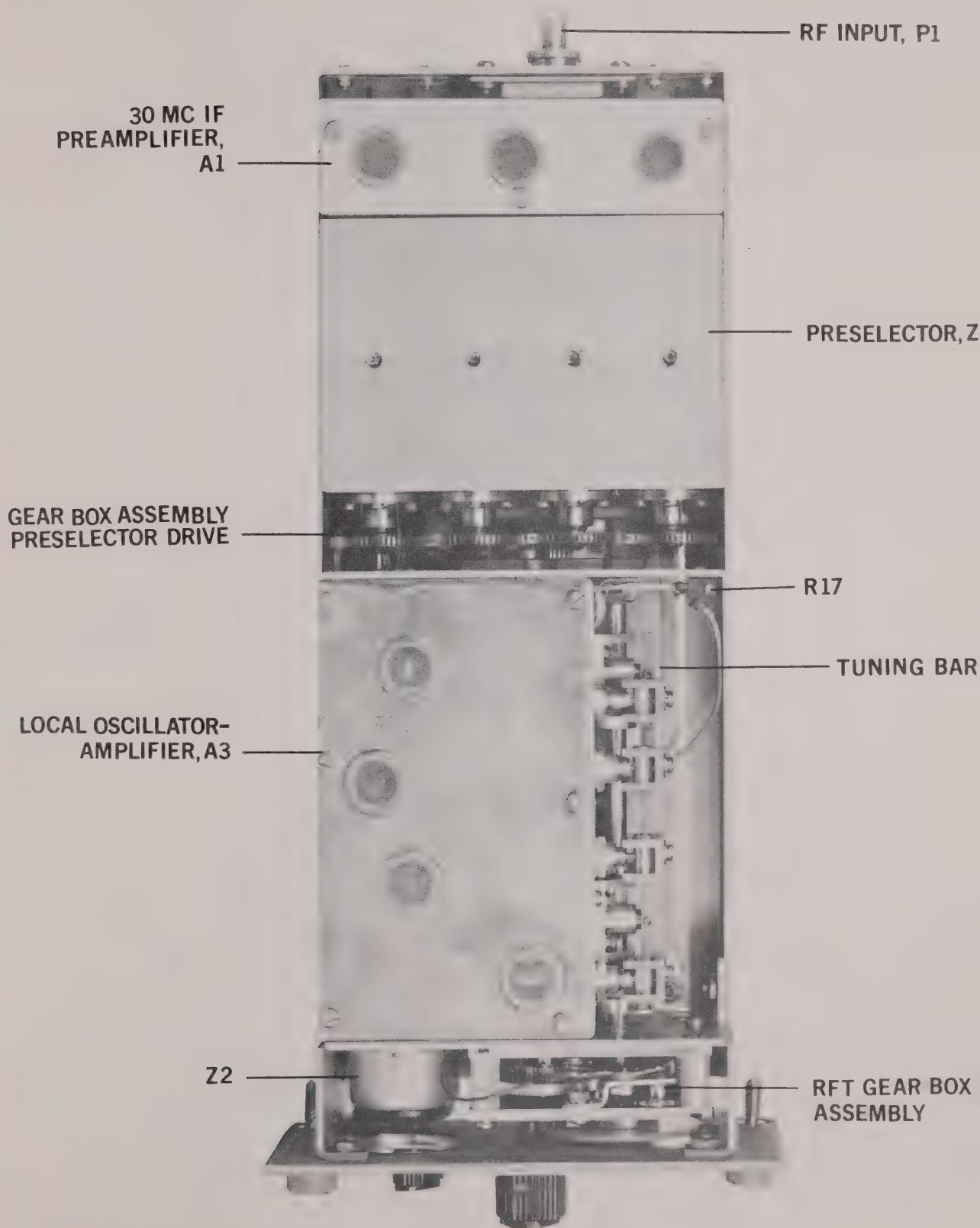


Figure 6-1. RF Tuner, Top View, Major Component Locations

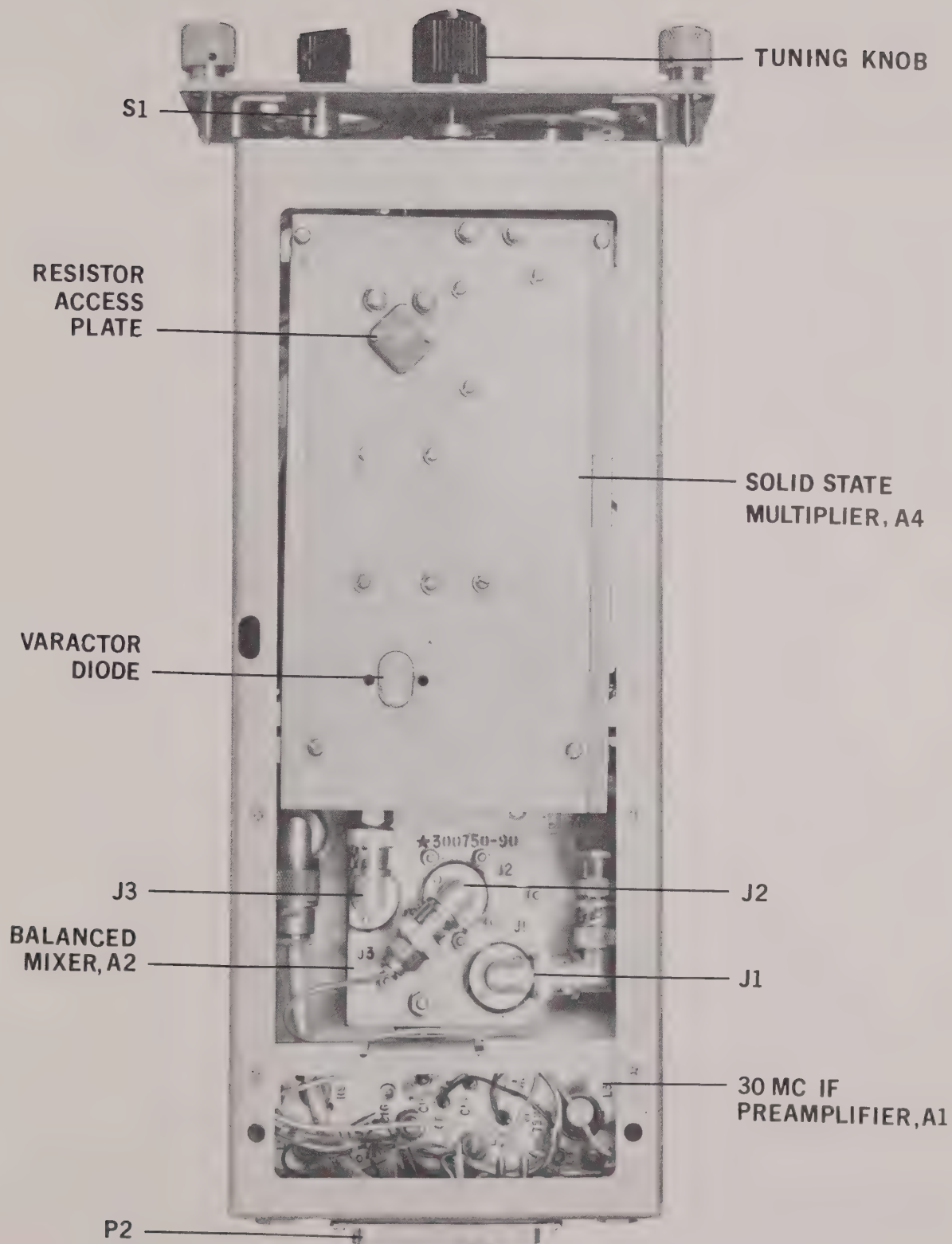


Figure 6-2. RF Tuner, Bottom View, Major Component Locations

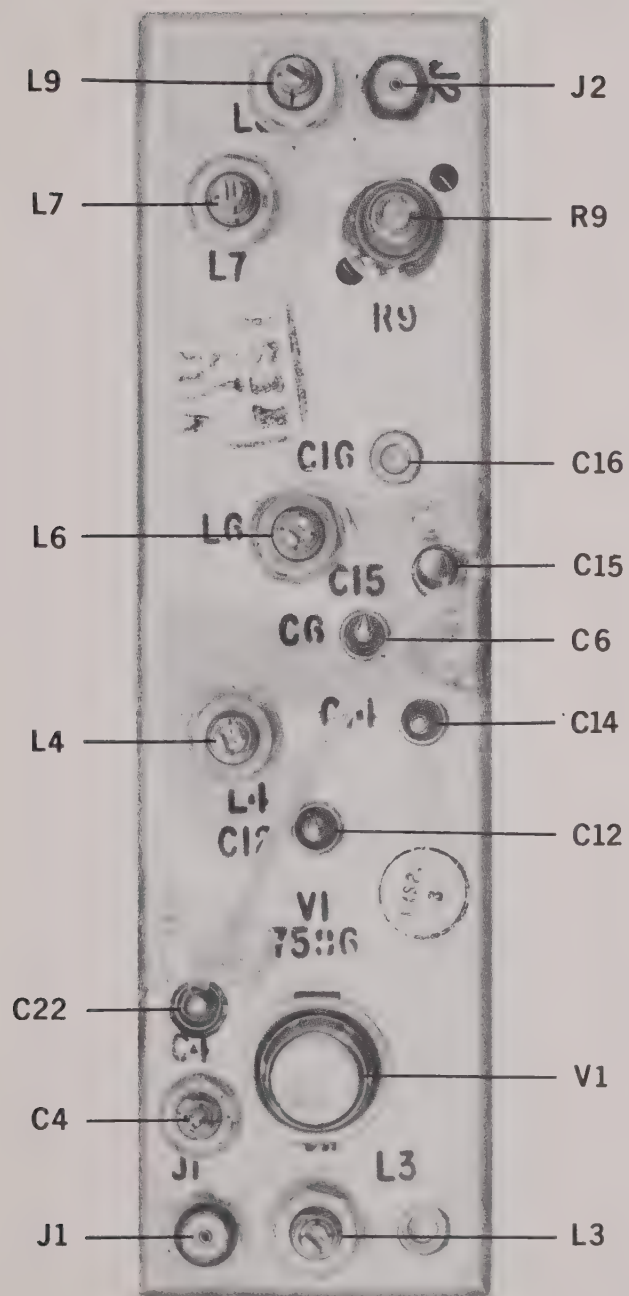


Figure 6-3. 30 MC Preamplifier, Bottom View

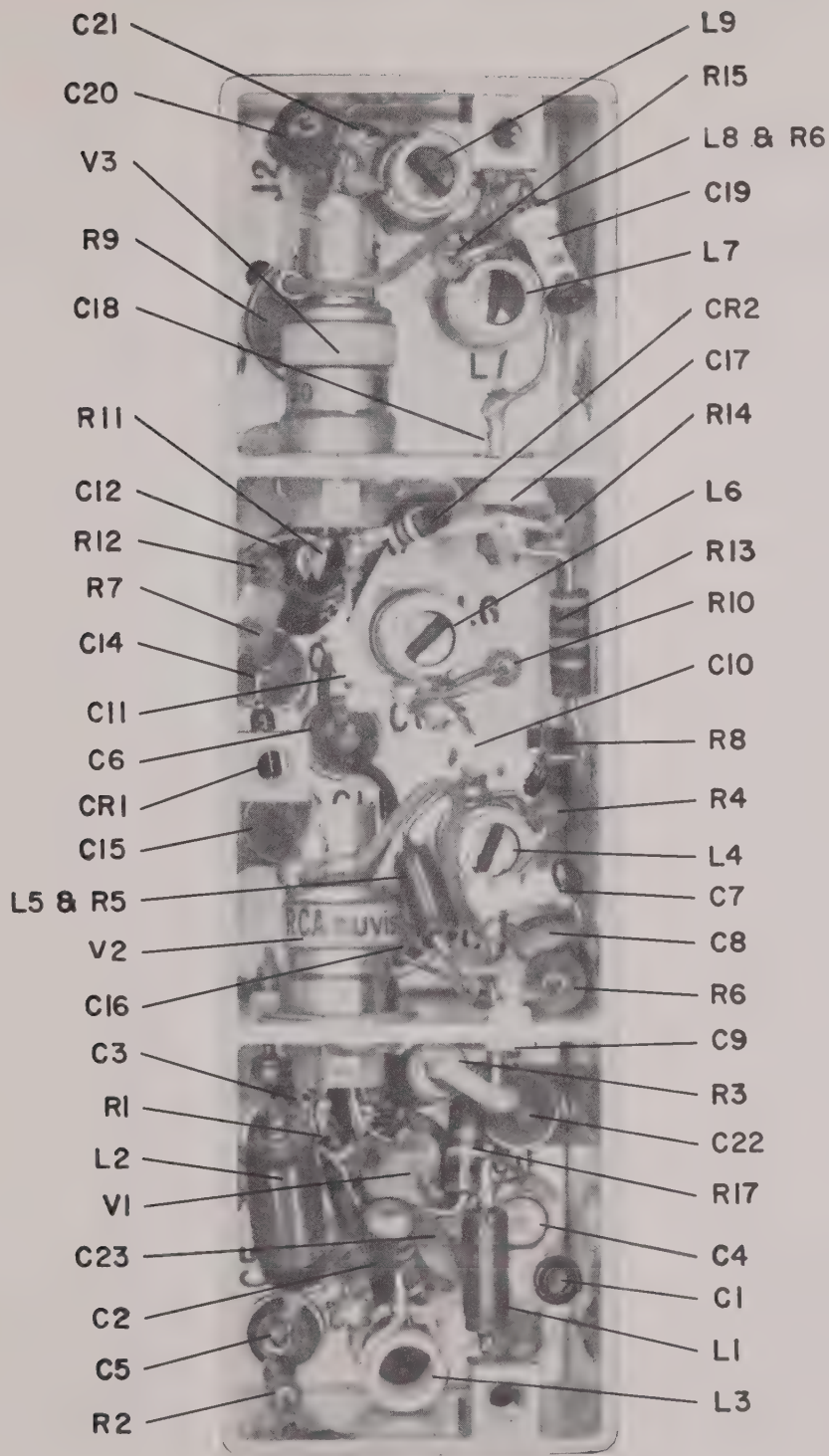


Figure 6-4. 30 MC Preamplifier, Location of Components

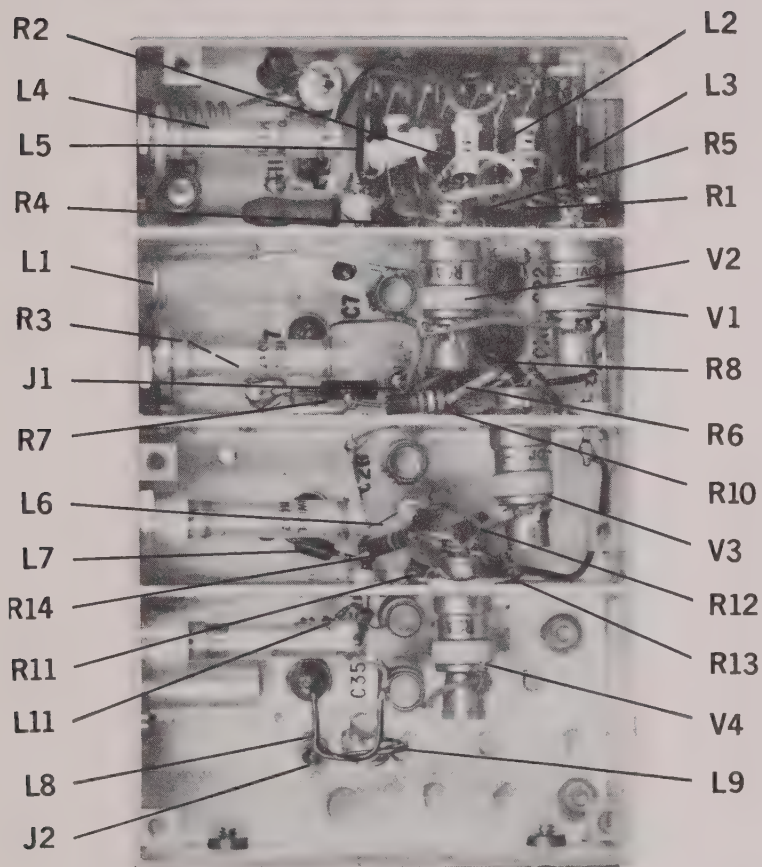


Figure 6-8. Local Oscillator/Amplifier, Location of Components (Except Capacitors)

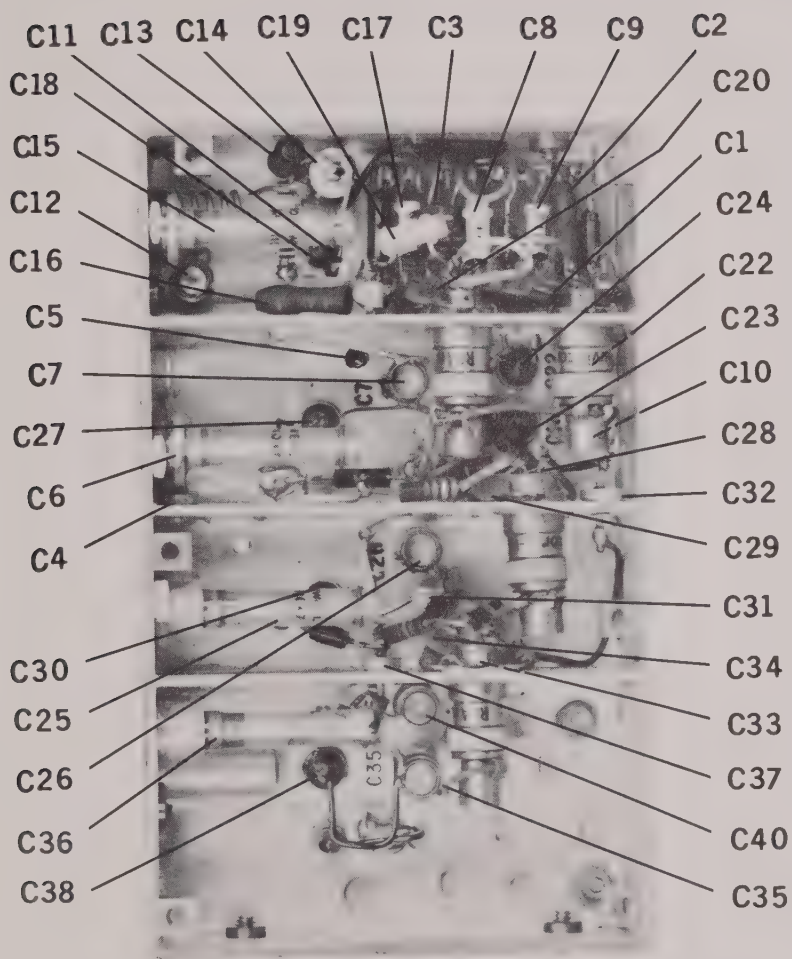


Figure 6-6. Local Oscillator/Amplifier, Location of Capacitors

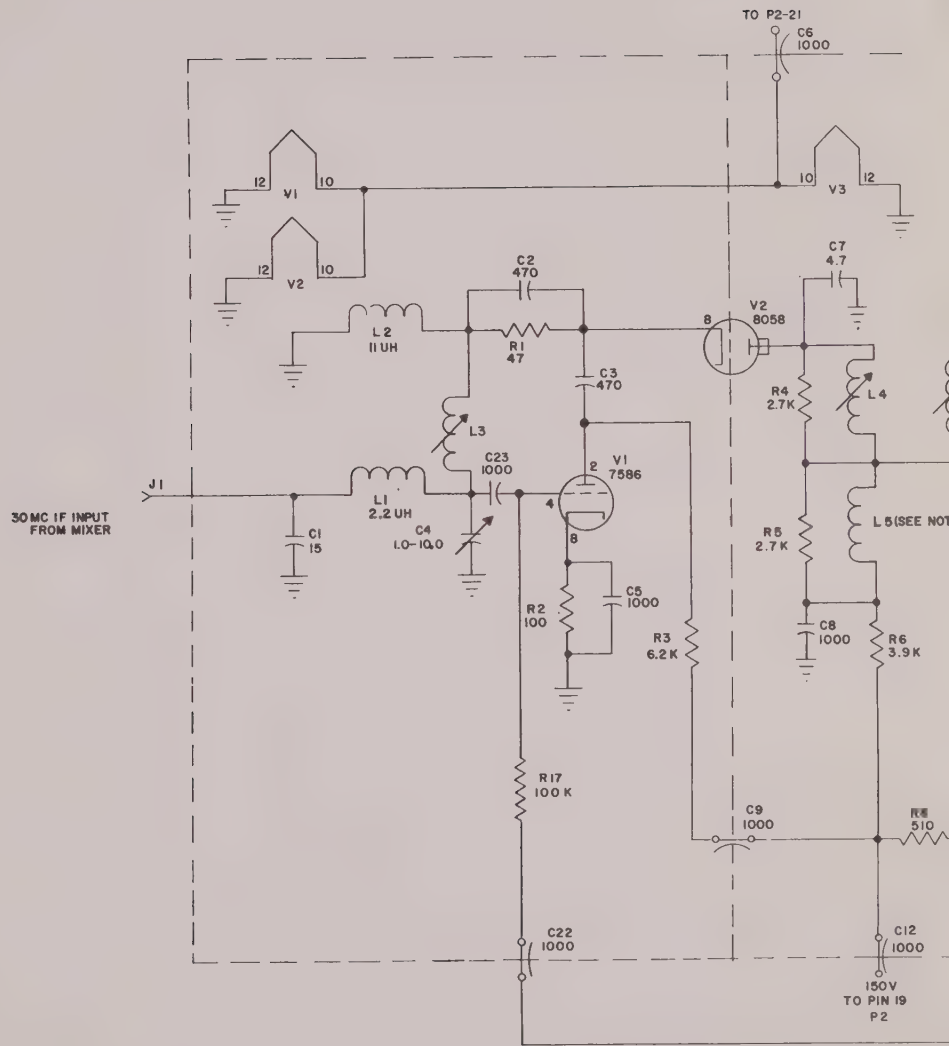
SECTION 7. SCHEMATIC DIAGRAMS

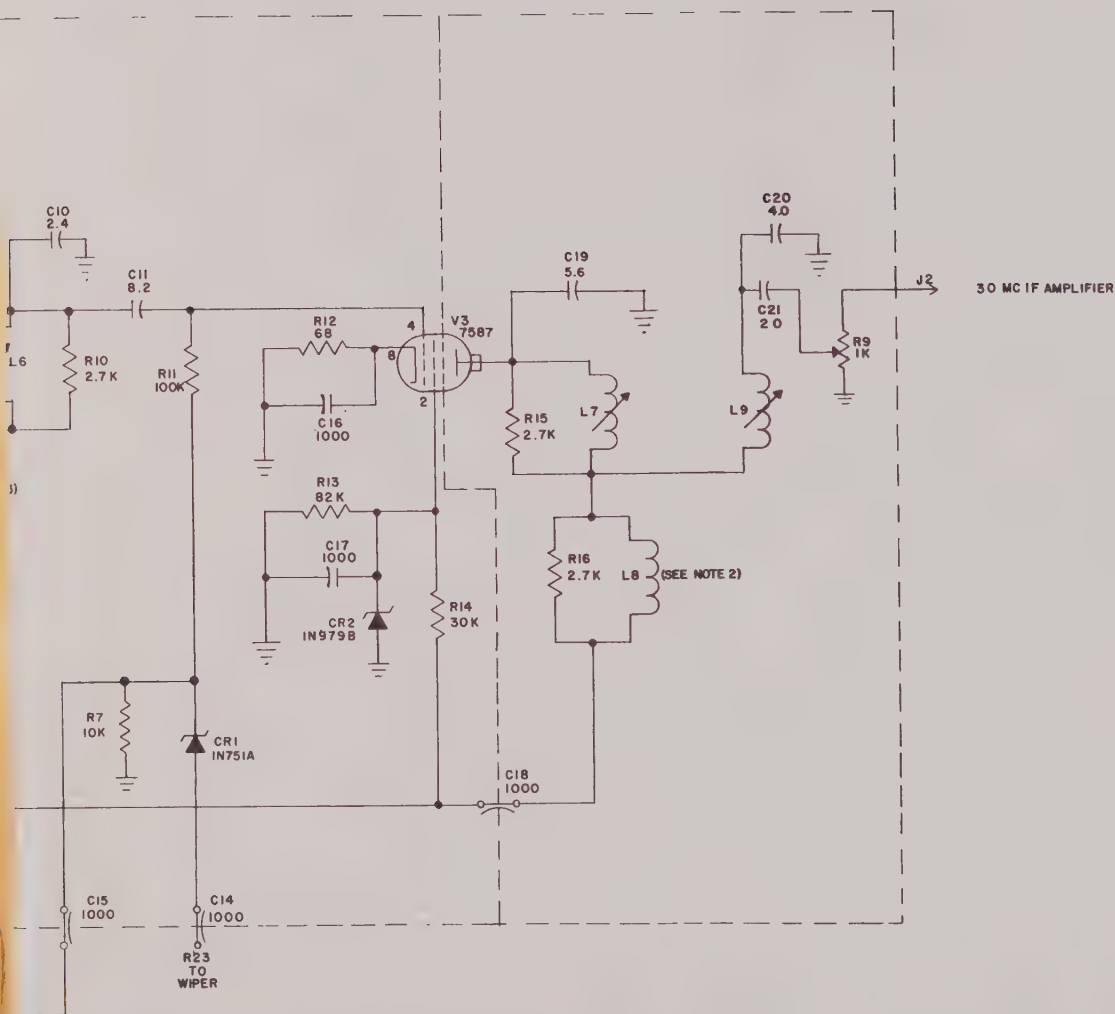
7.1 General

This section contains the schematic diagrams for the RFT-106A, RF Tuner.

The following schematics are included:

1. 30 MC IF Preamplifier, Schematic Diagram
2. Solid State X6 Multiplier, Schematic Analogy
3. Balanced Mixer, Equivalent Schematic Analogy
4. RFT-106A, RF Tuner, Schematic Diagram





NOTE:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSY DESIGNATION, OR BOTH.
2. L8 IS WOUND AROUND R16
3. L5 IS WOUND AROUND R5
4. ALL CAPACITORS ARE SHOWN IN PICOFARADS, UNLESS OTHERWISE SPECIFIED
5. ALL RESISTORS ARE SHOWN IN OHMS, UNLESS OTHERWISE SPECIFIED
6. ALL COIL VALUES ARE IN MICROHENRIES, UNLESS OTHERWISE SPECIFIED

Figure 7-1. 30 MC IF Preamplifier,
Schematic Diagram, 300681

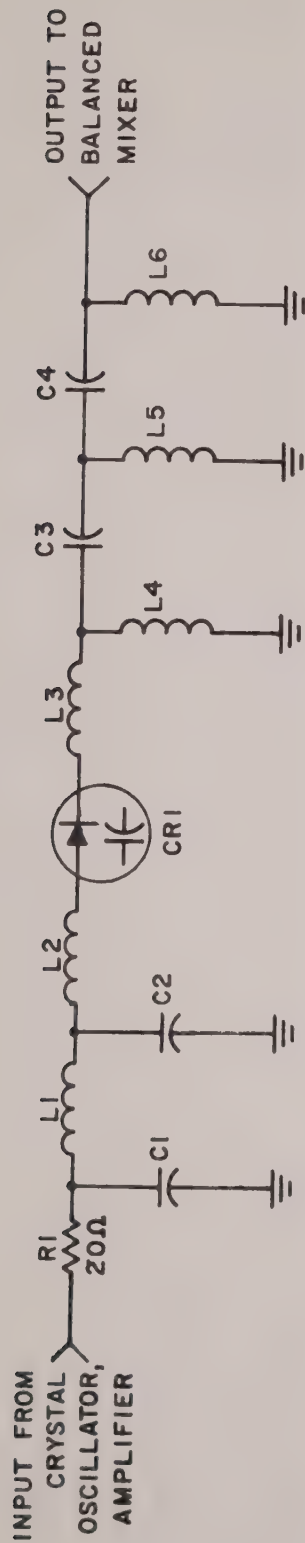


Figure 7-2. Multiplier (x6), Equivalent Schematic
Analogy

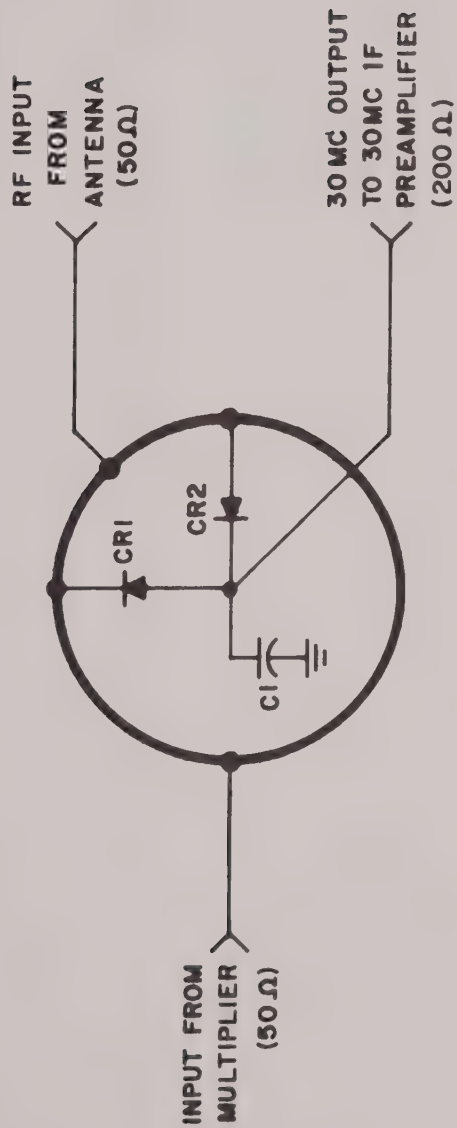
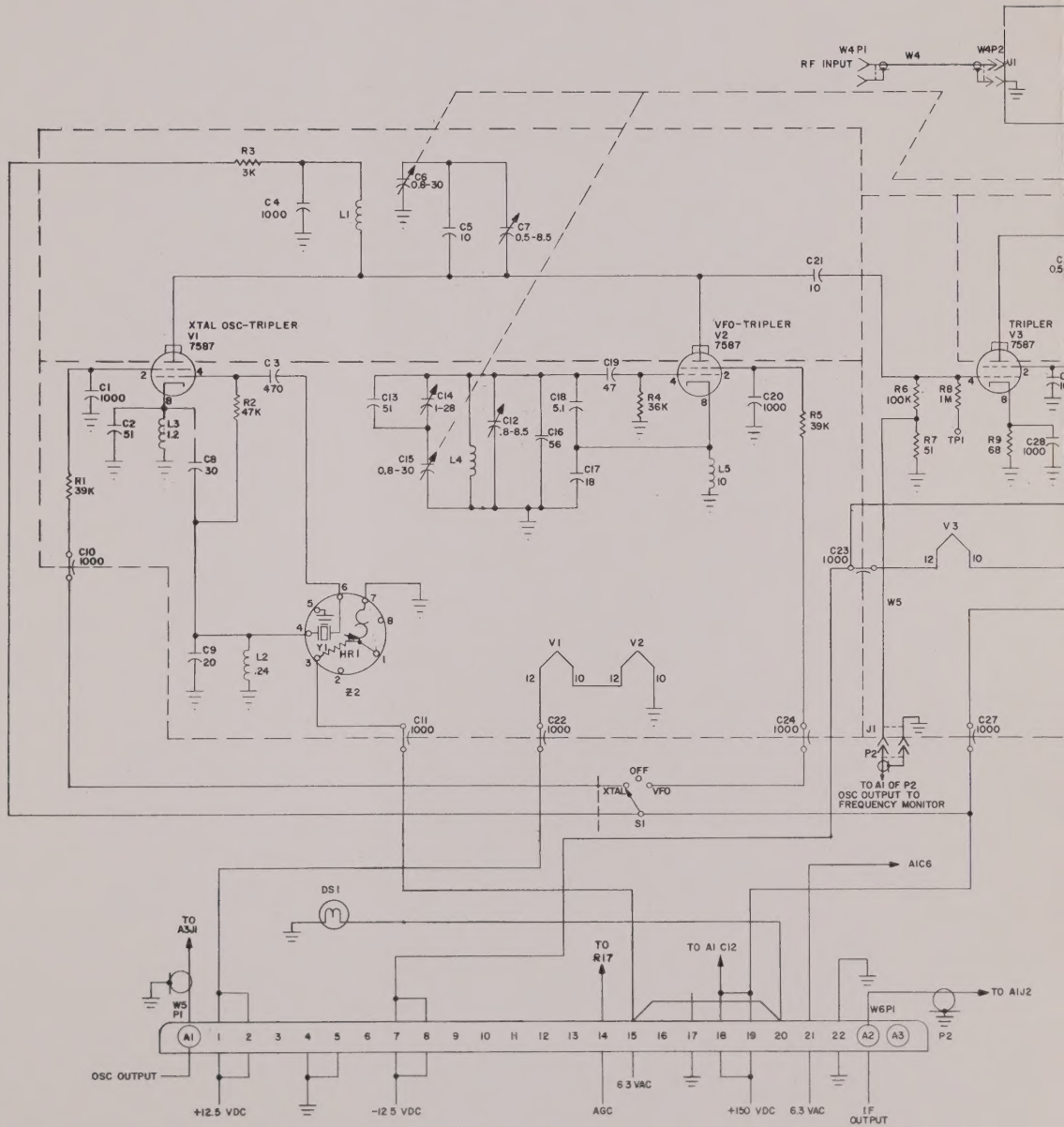
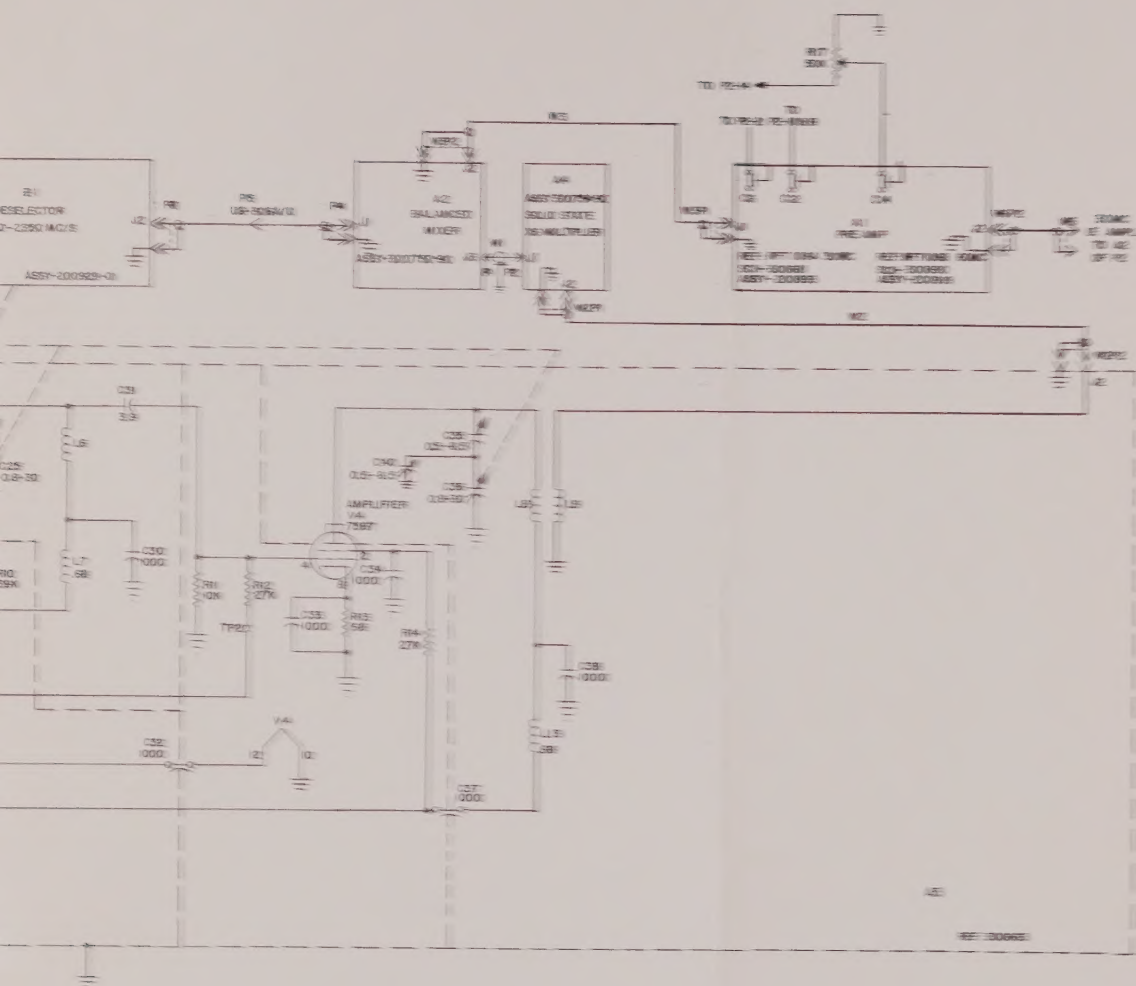


Figure 7-3. Balanced Mixer, Equivalent Schematic Analogy





NOTES:

1. ALL CAPACITORS ARE IN PICOGRAMS, UNLESS OTHERWISE SPECIFIED
2. ALL RESISTORS ARE IN OHMS, UNLESS OTHERWISE SPECIFIED
3. ALL COIL VALUES ARE IN MICROHENRIES, UNLESS OTHERWISE SPECIFIED
4. REFERENCE DESIGNATIONS ARE ABBREVIATED (PREFIXED DESIGNATION WITH UNIT NUMBERS OR ASSEMBLY DESIGNATION) OR LOST

Figure 7-4. RFT-106A, Overall Schematic Diagram (400138F)

